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## Tensiometer for Understanding Vadose Zone Processes

The Advanced Tensiometer is an instrument that accurately measures soil water potential, which is an important variable in soil water and chemical transport. Soil water potential indicates how tightly water is held by soil or rock and is related to moisture conditions in the soil. The Advanced Tensiometer works in the soil water potential range with the highest hydraulic conductivity, and thus with the greatest potential for rapid water movement. Advanced Tensiometers are deployed by lowering into a borehole and then brought into contact with the subsurface soil. Multiple instruments placed at various locations and depths assist hydrologists to estimate fluid movement between land surface and the water table.

Conventional tensiometers, with transducers located at the land surface, have a practical depth limitation of about 10 ft and are adversely affected by ambient temperature changes. The Advanced Tensiometer developed at the Idaho National Engineering and Environmental Laboratory (INEEL) has overcome the depth limitation of conventional tensiometers and is largely unaffected by changes in the ambient temperature. Advanced Tensiometers have been installed to depths exceeding 100 ft below land surface and have been continuously operated for about 3 years.

The Advanced Tensiometer design is simple, low cost, and low maintenance; there are no moving parts and electronic components are serviceable from land surface. The Advanced Tensiometer has two parts: (a) a permanently installed porous cup with a water reservoir and guide tube, and (b) a removable pressure transducer. Water pressure inside the instrument equilibrates with the surrounding soil and readings are obtained using a data logger at the surface.

The Advanced Tensiometer represents breakthrough technology that provides an order-of-magnitude improvement in soil water measurement precision and reliability at any depth in the unsaturated zone. Installed around waste disposal sites, the instrument can also be used as a pore water sampler to provide early warning of contaminant movement so that steps can be taken to protect public water supplies and avoid costly cleanups.

The Advanced Tensiometer has been successfully demonstrated in several geologic and climatic environments: the Radioactive Waste Management Complex at the INEEL; the Box Canyon site near Arco, Idaho; the INEEL Research Facility in Idaho Falls, Idaho; the Savannah River Site, South Carolina, the NRC low level research site at Maricopa, Arizona, and at the Oak Ridge National Laboratory, Tennessee.

***For further information on these tensiometers contact J.M. Hubbell ([jmh@inel.gov](mailto:jmh@inel.gov)) or J.B. Sisson ([jys@inel.gov](mailto:jys@inel.gov)).***

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